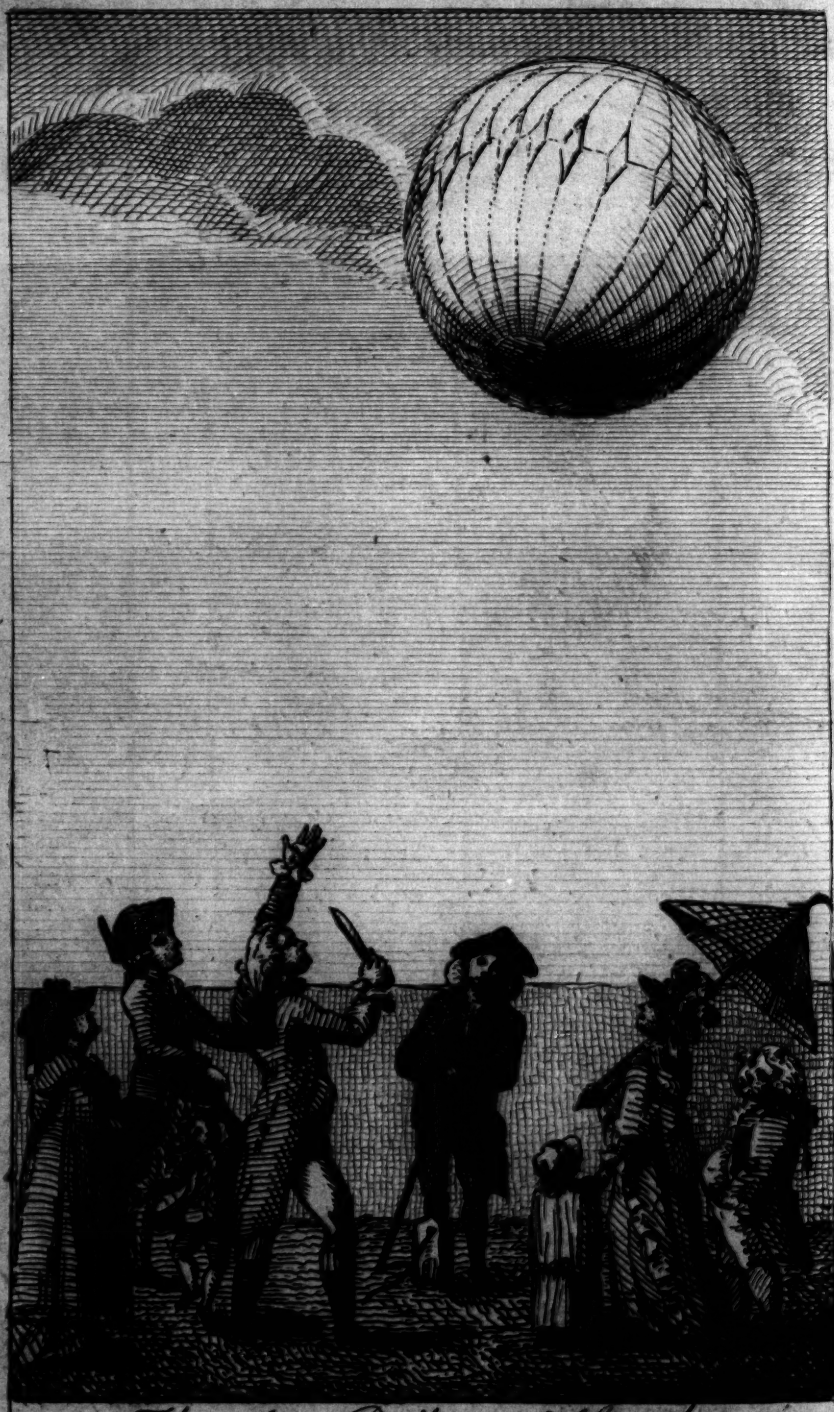
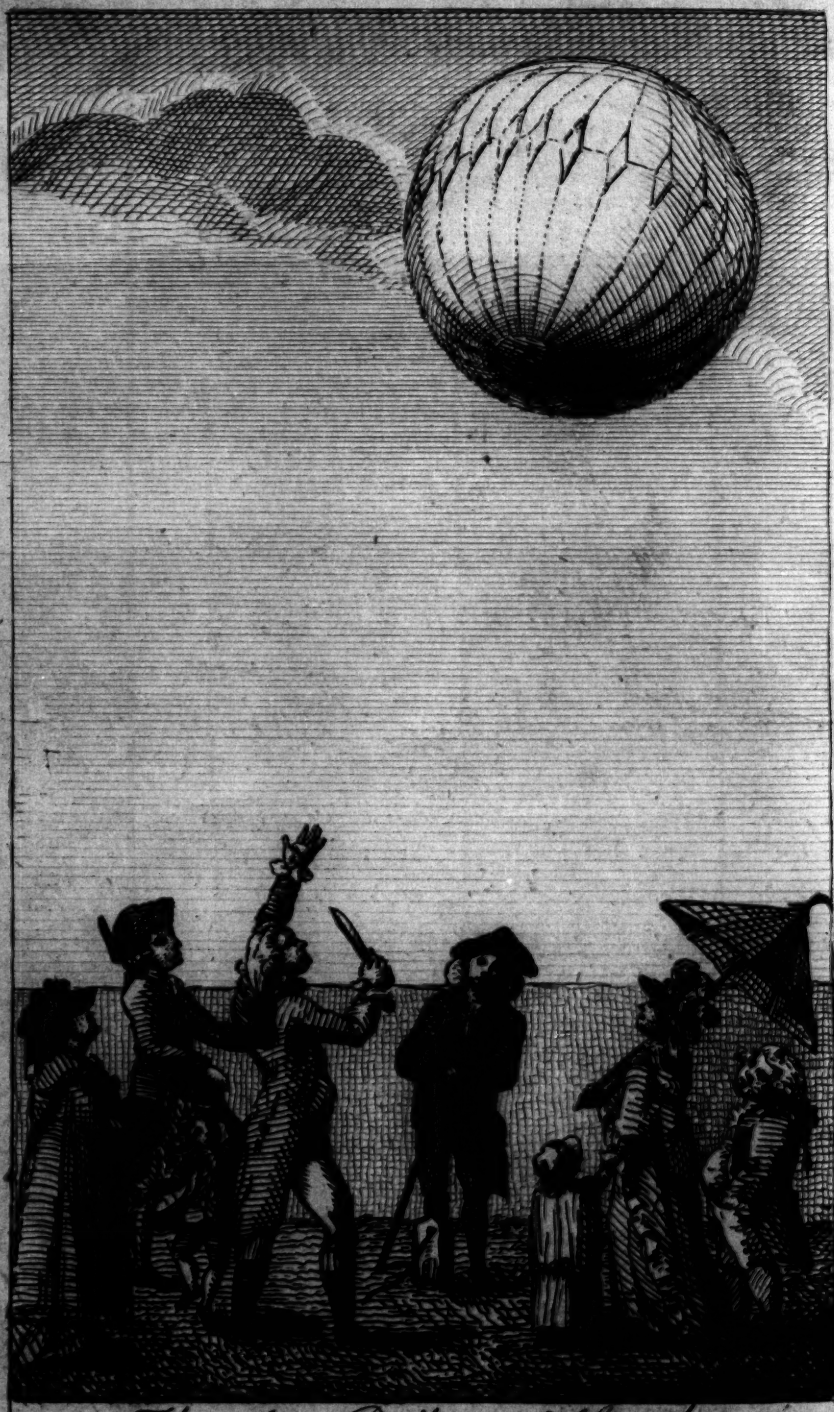


The Air Balloon Afcending.



The Air Balloon Afcending.

THE AIR BALLOON:

Or a TREATISE on

THE AEROSTATIC GLOBE,

Lately invented by

The celebrated Monſ. MONTGOLFIER of Paris.

SHEWING,

First—Thoſe Properties of Air, which influence an Air Balloon.

2dly—The particular Conſtruction and Methods of filling it.

3dly—Some of the great Variety of probable Uſes which this important Diſcovery may be applied to for the Benefit of Mankind.

The Whole rendered familiar to the plaineſt Capacity.

THE FOURTH EDITION,
With CONSIDERABLE ADDITIONS.

"To be impriſoned in the viewleſs winds,
"And blown with reſtleſs violence round about
"The pendent world."

SHAKESPEARE's Meaſure for Meaſure.

LONDON:
Printed for G. KEARSLEY, N° 46, Fleet-ſtreet.
M DCC LXXXIV.

THE AIR BALLOON.

IT has been amongſt the complaints of the preſent times, that whilſt we are travelling the road of Moral Philoſophy with ſome expedition, Natural Philoſophy has not alike been the object of our purſuit. And indeed, if we obſerve the ſpirit of toleration, which has of late been ſpreading itſelf thro' thoſe countries, where fanaticiſm and bigotry ſeemed to have taken up their eternal reſidence, and compare it with the falling off which has taken place of late years in the Philoſophical Tranſactions of Great Britain, this complaint will be found to have ſome claim. Whether this may be attributed to the ſuperior wiſdom of the preſent times, which is chiefly engaged about what "more immediately comes home to mens "boſoms" and occaſions, is not ſo eaſily determined. The preſent year, however,

has furniſhed us with an experimental improvement in Natural Philoſophy, which fully atones for her late repoſe, and which, if carried to the various uſes which probability will warrant us to expect, may prove one of the moſt novel and ſerviceable diſcoveries that this century has produced.

What is here alluded to is *Monſ. Montgolfier*'s late invention of the *Aeroſtatic Globe*, or *Air Balloon* — an experiment, which in a very few ages back would have filled the world with amazement and wonder, and perhaps have ſent the inventor to his grave with ignominy and diſgrace. The times, however, in this reſpect, are more enlightened; for whilſt this phænomenon produces novelty, and opens a wide field for ſpeculation and improvement—it gives due honours and rewards to the Philoſopher.

But ſuch is the ſtate of Natural Philoſophy, that, except in a very few inſtances, all diſcoveries and experiments

not

not only lie amongſt the learned, but the publications of thoſe diſcoveries are for the moſt part written in ſuch a technical ſtyle, and preſuppoſe ſo much ſcientific knowledge, that the generality of the world cannot readily comprehend them. By this I do not mean to ſay, that all ſciences are not perhaps better explained by terms adapted to that particular ſcience, provided the whole of the public were equally learned. But as this never can be the caſe—in all great and important diſcoveries, which may in ſome reſpect meet the ſpeculation as well as the general benefit of mankind—treatiſes adapted to ſuch capacities may have their uſe, by rouſing the attention of ſtrong, but unlettered minds, to add new diſcoveries out of the catalogue of more ſcientific reſearches—as it was a *paper maker* in Paris ‡ that firſt ſent this *Air Balloon* above our atmoſphere, who knows

‡ Monſ. Montgolfier.

but

but it might be reſerved for an Engliſh miller, or wheel-wright, to add wings, or ſome aerial rudder to guide it through thoſe regions with certainty and preciſion?

It is upon this principle I offer this little treatiſe to the Public, not attempting to explain any thing to the learned, who, from their particular ſtudies and experiments in this branch of knowledge, muſt know much more of the ſubject—but to ſatisfy the wiſhes of unlettered curioſity, by explaining, firſt, thoſe general properties of air, which influence an *Air Balloon*—ſecond, how an *Air Balloon* is conſtructed, and the methods of filling it—together with ſome of the probable uſes which ſuch a diſcovery might ultimately lead to for the benefit of mankind.

Air, in Philoſophy, ſignifies that thin and compreſſible body in which we breathe, and which ſurrounds the earth to a great height. The air is ſcarce to be perceived by ourſelves, but it ſufficiently diſcovers itſelf by the reſiſtance it makes

to

to bodies moving in it, and by its ſtrong motion againſt other bodies, which is called *wind*. The laws of our exiſtence and inevitable neceſſity oblige us to take in, and return this air, be it what it will; inſomuch, that all the aſſiſtances of art are vain, and all that is done for us in the common courſe of nature fruitleſs, if we are deprived of its benefits. Nor is this peculiar to man or animals alone; it is the grand and neceſſary inſtrument which Nature univerſally employs in almoſt all the operations ſhe is perpetually engaged in. There is ſcarcely any liquid, as appears by experiments, which has not air intermixed with it, or ſcarcely any ſolid out of which it may not be extracted.

But in order to obtain a more particular knowledge of air, it will be neceſſary to conſider diſtinctly ſome of its eſſential properties. The firſt, therefore, that offers itſelf to our conſideration is *fluidity*. This is ſo natural to it, that all the va-

rious

rious experiments which have been made, ſhew it cannot be deprived of it. Indeed, common obſervation, independent of chemical experiments, will fully prove this: for, in the ſharpeſt froſt, where every thing is congealed, the air alone remains *fluid*; nay, even in an artificial cold, forty degrees greater than ever nature has been obſerved to produce, the air ſtill retains its *fluidity*, notwithſtanding it is acted upon by ſuch a prodigious exceſs of Cold.

If you likewiſe compreſs the air with ever ſo great weight and force into the utmoſt denſity or compactneſs, yet it then does not become ſolid by concretion, or union of its ſeveral particles, but remains equally *fluid* as before, and as ſoon as ever the compreſſion is removed, it reſumes its former degree of liquidity. In the mean time it muſt be remembered, that the air concretes together, and unites with every ſpecies of known bodies, and ſerves as a kind of element in their compoſition.

poſition. This is ſufficiently evident from the large quantity of air, which, of its own accord, makes its way out of almoſt every body, whilſt it is analizing or reducing into its principles; and this is now uſually (though perhaps not altogether properly) called factitious or made air. The fact upon examination appears to be thus: air is contained in all known liquors whatſoever, it penetrates together with them into the receſſes of compound bodies; thus, at laſt, after a coalition of the whole, it remains locked up in the pores of thoſe bodies, as it were, in very minute veſſels, and afterwards the liquor, into which it was conveyed thither, being diſſipated, it is left there alone—Hence then it is evident, that this air was not concreted there, but only lay concealed, being retained by the including body. As ſoon as ever therefore it can diſengage itſelf from this confinement, it ruſhes out, not in the leaſt changed, and returns with velocity to its proper nature.

The ſecond property of air is that of *weight*, or *gravity*, which from numberleſs experiments (and particularly the following) is found to gravitate upon all inferior bodies.

Take a glaſs tube hermetically or chymically ſealed, fill it with raw mercury, and invert it, immerging the open end of a tube in a baſon or other veſſel filled with the ſame fluid, ſo that the cloſed end may be perpendicular to the ſurface of the mercury in the baſon. The tube being thus ſituated, the mercury will run out at the open end of the tube into the baſon; till it is about twenty-eight inches above the ſurface of the fluid contained therein; at which height, notwithſtanding the great ſpecific gravity of the mercury, it will remain ſuſpended in the tube. Now, it is certain, that nothing can ſuſtain the weight of the mercury in the tube, but an external preſſure on the ſurface of the fluid, and this can can be no other than the weight of the incum-

incumbent atmoſphere, which, not being counterbalanced by the air in the tube, raiſes, or ſuſpends when raiſed, a quantity of mercury, whoſe weight is equal to that of a column of air of the ſame diameter of the tube, in order to maintain an equilibrium.

And this appears evident from hence, that if you open the upper end of the tube, which before was cloſed up, the air by preſſing on the mercury in the tube with the ſame force as it does on the mercury without it, the former will ſubſide to the level of the latter. This is what is called "The *Torricellian* ex-"periment," from the Italian philoſopher *Torricellius* its inventor.—And on this principle depend the ſtructure and uſe of the barometer.

The weight of air is continually changing in proportion to the different degrees of heat and cold—but the weight of the common air, near the ſurface of the earth, at the time of the middle weight

of the atmoſphere, and in the moſt temperate ſeaſon of the year, is to that of water, as 1 to 850.

The third property of air is *elaſticity*. This is that ſingular quality by which all known air, poſſeſſing a certain ſpace, and being confined there ſo that it cannot eſcape, will, if it be preſſed with a determined weight, reduce itſelf into a leſs ſpace, which will be always in a reciprocal proportion to the quantity of the weight which it acts upon; with this circumſtance, however, that it will conſtantly, by a ſpontaneous expanſion, recover again the ſpace it had loſt, in proportion as the compreſſive force is diminiſhed. This property ſeems peculiar to AIR, there being no other *elaſtic* fluid in nature yet diſcovered.

The elaſticity of the air cannot be deſtroyed: for, upon examination, by every kind of experiment, it has always remained the ſame; nor are its principles either by long reſt, or the greateſt preſ-

ſure,

ſure, ever ſo altered as to loſe their *elaſticity*. The celebrated Mr. Boyle and Mariotte having, with a particular view to this, kept common air ſtrongly compreſſed and confined in a wind gun, found upon ſetting it at liberty, that it was perfectly as *elaſtic* as before; and Robervallius examining air, which had been confined in the ſame manner fifteen years, found that it had not loſt any of its *elaſticity*.

Mr. Boyle has likewiſe proved, that the *elaſtic* power, which prevails in any particular portion of the air, without any greater condenſation than what is owing to the compreſſing air itſelf, can ſuſtain all the force of a whole column of the incumbent atmoſphere; and alſo that this *elaſtic* power, in ſuch a very ſmall portion of air, can, by expanding itſelf, repel the bodies which compreſs it, with as much force as that which is exerted by the whole external body of the air.

A very

A very ſmall portion of air, therefore, wherever confined, is capable of producing the very ſame effects as a very large quantity in another place; for if any portion of common air is contained in a cavity that is eaſily compreſſible, it will then ſuſtain the whole preſſure, and entirely repel the whole body of the atmoſphere. And whenever the air contained in that place is heated by fire, or freed from its external preſſure, it immediately, by expanding itſelf, becomes ſo rare, as to produce effects equal to thoſe of the greateſt body of air.

Another law of the *elaſticity* of air is, that when it is condenſed to a certain degree, it acquires by the application of heat a greater power to expand itſelf than it had before; and this power of rarefaction ariſing from heat, has the ſame effect, as if that air had been rendered denſer, in proportion to the degree of heat which it before obtained. Unequal

maſſes

maſſes of air, but of the ſame denſity, are always equally expanded by the ſame degree of fire; ſo that theſe expanſions in the ſame degree of denſity, by a conſtant law of Nature, are always in proportion to the augmentation of heat applied.—Hence, if the expanſion of air of a given denſity by a certain degree of heat is once diſcovered, it will conſtantly hold good in all ſimilar caſes.

But with regard to the *great elaſticity* of the air, this is likewiſe conſtantly obſerved, that the more it is condenſed by preſſure, the greater elaſtic force it will acquire by the ſame degree of heat, and that nearly in a direct ratio of the denſities. Hence it follows, that a portion of air that is exceeding denſe may, by means of a very ſmall degree of heat, acquire the greateſt reſiſting force. Alſo, if you increaſe the denſity of the air, and at the ſame time augment the heat applied to it, the elaſtic power of the air will always be increaſed in a compound

ratio

ratio of both. The laſt law that is diſcovered in the elaſticity of the air is, that it is contracted into a ſmaller compaſs by cold, as it is by an increaſe of weight. Hence its denſity is always increaſed in proportion to the intenſeneſs of the cold.

Having thus deſcribed the three leading properties of Air—we now come to explain how this Element is applied in the conſtruction of an *Air Balloon*.

From the nature of air we find, that any factitious air which is lighter than the atmoſphere aſcends.—We ſee this by that air which is produced by a fire, called *ſmoke*, which being ſpecifically lighter than the atmoſpheric air, is carried up the chimney, and only ſettles when it gets to that height which is equal to its own levity. This quality of air has been long underſtood, and various theories have been ſuggeſted to what purpoſes it may be applied. Though Monſ. *Montgolfier*, we believe, was the firſt European

ropean philoſopher who made it a *travelling convenience* for man, and gave to the world an experiment, which is likely to become as uſeful as it is at preſent curious.

The methods of making the air which fills this *Aeroſtatic Globe* are as follow;

Take a certain quantity of oil of vitriol, in the proportion of an ounce to a quart of water, and mix both with filings of iron; theſe produce a factitious air, ſuppoſed to be about ten times lighter than the atmoſphere. This air ſo made is by a tube conducted into the *Air Balloon* ſo as not to give it all the fullneſs of a common bladder, but rather looſe in ſome parts, and this keeps it the longer from burſting in its progreſs through the air. The form of the *Air Balloon* is orbicular, or round—it is generally made of taffeta, or thin ſilk, on account of its lightneſs, and gummed on the ſeams, the better to prevent the air from tranſpiring. When it is properly filled, it is cloſely tied at the end, and from this moment

it becomes ſo much a lighter body than the circumambient air, that it would immediately aſcend, if not reſtrained by a proportionate balance. When it is let off (which is done by cutting the ſtrings which reſtrain it) it riſes for ſome time perpendicular, and rather ſlowly; it then follows the direction of the wind in a progreſſive aſcent, till it reaches that region of air which is lighter than itſelf. This air repels it with that force, ſo as either to burſt it, or force out by degrees the factitious air; in either caſe it deſcends with rapidity to the earth.

From this method of uſing an *Air Balloon*, the Public will readily ſee, that the experiment can only gratify curioſity —as very little or no uſe can be made of it, there being no poſſibility of reſtraining its height, or preventing its rapid declenſion—in either caſe it muſt be fatal to any perſon to aſcend with it; as it may travel through regions of air too rarefied for human reſpiration, and fall with

with ſuch rapidity as to daſh him to pieces.

To remedy this, the ſame ingenious inventor has adopted another method of filling his *Balloon* by which he has ſecured its aſcent and deſcent with more certainty and ſafety; which is, inſtead of oil of vitriol, water, and filings of iron, to make his air of that ſmoke which is produced by the burning of wet ſtraw, and by carrying a quantity of this fuel with him (in a little gallery conſtructed round the Balloon, for the purpoſe of feeding it) he can aſcend or deſcend at pleaſure.

The method of ſupplying this laſt *Balloon* with air is, by burning the ſtraw on a grate affixed to the bottom of it — the ſmoke of which is infuſed into the Balloon by a tube, to which there is a cock to let it out as occaſions may require.

Of this he has made ſeveral experiments in the preſence of many thouſand ſpectators in Paris; amongſt whom were

ſome of the firſt rank in life and letters. —But the greateſt experiment which has as yet been made, was that on the 19th of October laſt by the Sieur *Giroud de Villette* and Monſ. *Rozier*. The Balloon conſtructed for this purpoſe was ſixty feet long and forty broad, which being filled with air made by the ſmoke of wet ſtraw was capable of taking up theſe two enterprizing Philoſophers, together with the weight of the gallery attached to it, and ſeveral pounds weight of fuel.

They took the opportunity of a day when the wind blew acroſs the city of Paris, and aſcending at one ſide Port St. Jacques, croſſed over to the Fauxbourgh St. Martin, that is, by way of making it more familiar to an Engliſh ear, (ſuppoſing the experiment was made in London) as if they aſcended at St. George's Fields, and traverſing acroſs the city, came down in one of the fields near Iſlington.

The

The height they aſcended was made by a computation, which was taken as they paſſed over the church of St. Sulpice, and is ſaid to be 1650 feet, which is more than four times higher than St. Paul's. In this region (contrary to the received opinion of moſt philoſophers, that man could not live in ſuch rarefied air) they could breathe freely; and ſo ſupported were they by the enthuſiaſm of their enterprize, that they had reſolution enough to enjoy the birds eye proſpect of ſo ſtupendous a height, and clearly ſee Neuilly, St. Cloud, Seve, Iſſy, Ivri, Charenton, and Choiſy—Some of thoſe place 48 miles from the capitol. The gardens about Paris appeared to them like *bouquets*, and the people paſſing and re-paſſing (according to the ſtrong expreſſion of Monſ. Rozier) "*like ſo many "mites in a cheeſe.*"—No bad ſituation to humble the pride of man, and make him feel his individual littleneſs and inſignificancy in the great ſcale of Creation.

In

In reſpect to the weight an *Air Balloon* can carry, it muſt depend on the ſize. That conſtructed by Mr. Biaggini, and lately let off in the Artillery Ground, Moorfields, was ten feet diameter, and could have carried about ſixteen pounds*—ſo that by a computation of this kind, on a more enlarged ſcale, the exact weight can be readily aſcertained—that lately ſent up in Paris, which we have been juſt deſcribing, was ſixty feet long, and forty broad—and muſt have carried up (computing the weight of the two men, the gallery, and ſtraw) not leſs than between three and four hundred weight.

In reſpect to its rate of travelling in the air, we may very well ſuppoſe it at leaſt fifteen miles an hour from the average calculation of experiments which

* Mr. Biaggini has juſt now prepared another *Air Balloon*, which he is exhibiting at the Pantheon, and which he ſhortly intends to let off in the Artillery Ground, 16 feet diameter, and of force ſufficient to carry up a child of eight years old.

have

have been made, without allowing for the loſs of time in the perpendicular aſcent, and the obſtructions it is ſubject to meet with from the ſhiftings of the wind; and if in any future diſcovery we ſhould be able to direct its courſe, there is no doubt it will travel with ſtill more velocity.

Such is a brief and plain deſcription of an *Air Balloon*, which has with ſo much juſtice rouſed the curioſity and attention of all Europe—a diſcovery, we muſt confeſs, hitherto merely curious, but which bids fair, from the probable improvements which may be made in it, to be highly ſerviceable to ſociety.

At preſent however, by this invention, we can only aſcend and deſcend, and the latter, perhaps, not always with the moſt perfect ſecurity: it is beſides at the mercy of the wind, "*to be blown with reſtleſs* "*violence round about this pendent world.*" The firſt object of improvement therefore will

will be to direct its motion in the air by the means of *wings*, or *feathered oars*. This may appear visionary to some; but we have authority to assure the Public, that not only the original inventor of the *Air Balloon* is busied in this project, but something of a similar nature is now in great forwardness amongst ourselves, under the direction of a Scotch artist, who is already supported by a subscription of seven hundred guineas to complete it.

The machine is to be in the form of a bird; the body is to contain the inflammable air; the shaft of the wings to be nine feet long, and nine inches wide; both to be made of the purest elastic steel ever wrought in this country, and the whole is to be worked and directed by a person who is to go up in a basket attached to the machine.

This once obtained, the uses which might arise from it are many and various.

On the first report of a country being invaded, an *Air Balloon* would save the

expences

expences of meſſengers, poſts, &c. from the coaſts to the main army, as at the height it aſcends, with the aſſiſtance of glaſſes, the number of the enemy, together with their place of landing, might be communicated with great diſpatch.

A general likewiſe in the day of battle, would derive ſingular advantage by going up in one of theſe machines; he would have a bird's eye view not only of every thing that was doing in his own, but the enemy's army, and by ſending down his orders occaſionally (which may be done by the means of a plummet) he may literally be ſaid

'*To ride in the whirlwind, and direct the ſtorm.*'

Obſervations at Sea may likewiſe be made at a greater diſtance, and with a greater certainty than at preſent, which would not only be uſeful in time of war, and preventive of accidents at all times, but add perhaps extenſive diſcoveries to our terreſtrial globe.

During ſieges they may be rendered particularly uſeful, by obſerving the works of the enemy, and of courſe rendering them ineffectual. Had this diſcovery been known even ſo late as the ſiege of Gibraltar, it would have ſaved that brave garriſon ſome lives, and great labour, as occaſional turrets were obliged to be built the better to obſerve the operations of the enemy—all which an *Air Balloon* would have ſaved. In caſes of fires in capitals or large towns, an *Air Ballloon* let off would inſtantly aſcertain where the fire was, and of courſe occaſion a more direct and ſpeedy aſſiſtance.

To maintain a war of poſts, as was pretty much the caſe in the late war in America, an *Air Balloon* would be of the moſt ſingular advantage. For inſtance, had the troops in that unfortunate expedition to Albany been provided with this celebrated diſcovery, to give neceſſary ſignals and intelligence to the detachment who were to ſupport them; the effects

of

of that unfortunate day would not be recorded, as they now are, in the debilitated and humiliating ſtate of Great Britain.

In Natural Philoſophy it bids fair to make many great and conſiderable improvements. It is well known, that our great philoſopher Dr. Franklyn, by means of an artificial Kite, has already drawn down lightning from the clouds: Why may not this experiment be improved by means of an *Air Balloon?* When the appearance and approach of clouds prognoſticate immediate thunder, an *Air Balloon* carrying up conductors might draw it down, and ſeparate that force, which oft has proved fatal to the lives of many. In the Weſt and Eaſt Indies, where thunder ſtorms are infinitely more frequent and miſchievous than in theſe countries, it would be a diſcovery of the moſt ſalutary kind, and as its objects would be of ſuch material advantage to the natives, there is little doubt but ſuch fur-

ther improvements may be made, as the very bad effects of thunder may in a great meaſure be prevented.

Phyſics may keep equal pace with the other improvements in Natural Philoſophy: for as the great organs of our ſenſes, taſting, feeling, hearing, and ſmelling, are communicated to us thro' the medium of the air, who can ſay what improvements the conſtitution might receive from ſuch quick and elevated changes? We all know, that ſome invalids are only kept alive by what phyſicians call the *change of air*, that is, by travelling from one country or town to another—but as the air is always allowed to be purer in its *aſcent*, and as an *Air Balloon* can regulate that aſcent to preciſion, the benefits may be of the moſt valuable kind. In *aſthmas* and *decays* it may turn out a ſpecific, and in other diſeaſes, though not ſo powerful, yet highly ſerviceable.

In ſhort, as the various properties of air are at preſent ſo well known to contribute to the preſervation of our exiſtence,

ence, what are we not led to hope from a knowledge of uſing it, and living in it in a purer and more extenſive degree than ever? The preſent period ſeems to be a favourable omen for the extenſion and encouragement of this diſcovery—as PEACE, the parent and patron of all knowledge, has happily once more reviſited Europe, and calls upon its philoſophers and artiſts to eraſe the ravages of war, by the cultivation of uſeful and ornamental ſcience.

SINCE writing the above, the Editor is favoured with a letter from a reſpectable correſpondent in Paris, dated the 3d of December, acquainting him of a late experiment made of the *Air Balloon*, which he is happy in laying before the public, as it in a great meaſure juſtifies the ſanguine hopes he entertains of its further improvement.

" On

" On Monday the 1ſt of December an *Air Balloon*, under the direction of Meſſrs. Charles and Roberts, was let off from the Thuilleries. It had ſuſpended to it a baſket, covered with blue ſilk and paper finely gilt, in the ſhape of a triumphal car, in which Mr. Charles and Mr. Roberts embarked, and mounted up into the air, amidſt many thouſands of people of all ranks and conditions, perhaps three or four hundred thouſand. Beſide the Duke de Chartres and a great part of the French nobility, there were the Duke and Ducheſs of Cumberland, the Duke and Ducheſs of Mancheſter, and many other foreign princes and nobility. The philoſophers had flags with them of different colours, with which, as they mounted aloft, they ſaluted the admiring world below. When they came to the height at which they meant to ſail (which was computed to be about twice the height of St. Paul's) they threw down a flag as agreed. They then glided along a ſteady horizontal track over the Faux-bourg St. Honore, ſaluting the people as they went along, with their flags; and landed at about 20 miles diſtance

from

from the place they ſet out from, being accompanied (*ſur la terre*) by the Duke de Chartres, and ſeveral of the French and Engliſh nobility and gentry, who came in almoſt at their landing. Mr. Roberts then got out, when Mr. Charles, after throwing out ſome ballaſt to lighten the machine, aſcended alone in the *Balloon* to the almoſt incredible height of 15026 toiſes, or 3052 yards perpendicular, in about ten minutes.

" The account Mr. Charles gives of his obſervations during this time (which is publiſhed in the Journal of to-day) is, that he loſt ſight of every thing below upon earth, and ſaw nothing but a wide expanſe of fine æther—that the Barometer fell from 28 to 18, and the Thermometer from 7 above freezing to 5 below it. He deſcended about four or five miles from the ſpot he got up, near the houſe of a Mr. Farrar, an Engliſh gentleman, where he ſlept that night, and was brought to town by a nobleman in his own carriage the next day, amidſt the general acclamations of the Public.

" The Balloon was compoſed of red and ſtraw-coloured taffeta, which were pieced

pieced alternately, ſo as to appear like meridional lines upon a terreſtrial globe. The upper hemiſphere was covered with a netting, ſurrounded at the bottom by a hoop, to which the car was ſuſpended; ſo that the elaſtic preſſure of the inflammable air was equally repreſſed by all the meſhes of the net above. Monſ. Montgolfier attended during the whole of the experiment."

We are ſorry to add to this account, that on the arrival of Meſſ. Charles and Roberts in Paris, they were arreſted by order of the King, who, as *father of his people*, was adviſed by ſome bigotted Eccleſiaſtics to prevent the farther endangering the lives of his ſubjects.—But as great intereſt is making for them by the princes of the blood, together with all the philoſophers in Paris, it is thought they will ſpeedily be diſcharged. Public curioſity is much damped by this circumſtance, as the next experiment Mr. Charles meant to make of the *Air Balloon* was to take a trip in it from Calais to Dover, in which he was to be accompanied by the celebrated Monſ. *Bougainville.*

THE END.

POSTSCRIPT.

THE very rapid and extenſive ſale of this little Treatiſe, which the Editor ſent into the world with no other view, than to make familiar to ordinary capacities, an invention which may be further improved for the benefit of mankind, induces him, in this Edition, to report what further trials and improvements the *Air Balloon* has ſuggeſted to the philoſophers of this country.

When the Editor ſtated the great variety of probable uſes which this diſcovery might be applied to, he was aware that he ran ſome riſque of obtaining credit with the indolent, the ſceptical, and unlettered part of mankind; for ſuch is the nature of man, that from pride, and a variety of other cauſes, equally unphiloſophic, few will be brought to acknowledge the poſſibility of effecting what they do not comprehend, particularly if the object is much out of the latitude of common underſtanding. It was upon the errors of this principle that Columbus had nearly abandoned the project of diſcovering America, that the famous Gallileo was impriſoned ſix years in the Inquiſition; and to come more immediately to the point, that our modern philoſopher, Montgolfier, had not totally given up this his diſcovery; as on his firſt expedition, the *Air Balloon* not riſing proportionably to public expectation, (owing to too ſmall a quantity of inflammable air) the populace were growing clamorous, and had he not at laſt ſucceeded, would not only have prevented him a ſecond trial, but perhaps have made him pay dear for the firſt.

Time, however, the ſettler of moſt things on their true baſis, has given to this philoſopher the full credit of his invention. The public no longer doubt, becauſe they ſee that an *Air Balloon*, filled with inflammable air, aſcends, and that it carries up a weight proportionate to its magnitude. This fact ſo oft repeated, they likewiſe begin to think it poſſible ſome further diſcoveries may be made, to

render it uſeful as well as curious; and the philoſophers of Europe, ſeeing this propenſity of the public, and feeling the ardour of ſcience, are now bending their minds to a ſubject where they are ſure of meeting encouragement and approbation.

In this liſt, we are happy to acquaint the public, that two of our own countrymen are now buſily employed on different projects, which if they can bring to perfection, it is impoſſible to deſcribe the number of uſeful purpoſes this invention will give birth to.

The firſt philoſopher ſeeing that an *Air Balloon* is at preſent entirely governed by the wind, and ſubject to all its changes and ſhiftings, has added a pair of artificial wings to the body of the Balloon, to be worked by the perſon who goes up in the baſket. This we hinted, in the firſt edition of this pamphlet, to be in ſome forwardneſs; it is now compleated, and the artiſt, very early in the Spring, will begin the firſt journey that perhaps was ever undertaken by man—*a journey through the air*, where, in the language of our divine Bard, he may be literally ſaid "to ride upon the ſightleſs couriers of the wind."

The ſecond artiſt demands our wonder more, as he ſcorns the auxiliary of an *Air Balloon*, and means to traverſe the air in what direction he thinks proper, by the aſſiſtance of a machine in the form of a canoe, to which are to be attached a pair of artificial wings and tail. This apparatus is now nearly compleated, the wings are nine feet by nine inches, the tail about a yard and a half long, both made of the pureſt elaſtic ſteel, and to be worked at diſcretion by the artiſt as he ſits in his canoe.

This wonderful attempt the Editor has ſeen and examined, through the courteſy of the Inventor, who adds urbanity to a love of ſcience. The wings are ſaid to be conſtructed on the model of thoſe of the Weſt India crow; and the tail, though not ſo long, has ſomewhat of the plumage of a peacock. Theſe the artiſt works with great facility, ſpreading and contracting both at pleaſure, and he now only waits to commit them to the air till a ſecond pair of wings are ready for him to uſe in caſe of any accident happening to the firſt.

However ſtrange this laſt project might appear, and however impracticable it may be thought for a man to ſupport his own weight with that of his apparatus, merely by the aid of artificial wings, the idea is not new in this country; the celebrated Biſhop Wilkins, a very grave and learned prelate

late of the laſt century, was ſo poſſeſſed of the certainty of effecting this, that he wrote a book upon it, explaining its practicability upon philoſophical principles. The age he lived in was not, however, ripe enough for his theory; had it been preceded by the ſucceſs of *Air Balloons*, there is no doubt but the public would have given him a patient trial, when perhaps he, who in this inſtance was treated as a viſionary, would be conſidered a great experimental philoſopher.

Leaving thoſe two very extraordinary attempts to the ſucceſs which bids fair to await them, the Editor cannot cloſe this poſtſcript without laying before the public an account of the laſt experiment which has been made of the *Air Balloon*.

On Thurſday, the 18th of December laſt, an *Air Balloon* was launched by a Mr. Dinwiddie from the Bowling Green Tavern, near Buckingham Gate; its ſize was much leſs than that let off by Mr. Biaggini at the Artillery Ground. Its form longitudinal, very much reſembling that of a pocket of hops; it was about three yards long, and four feet circular. Previous to its launching, the artiſt found there was not air enough to enſure its aſcent, he therefore, in the preſence of the ſpectators, filled it exactly after the manner preſcribed in this treatiſe,* by a mixture of oil of vitriol, filings of iron, and water, placing one end of the tube through a hole in a ſmall caſk, where the fumigation was made, and the other in the neck of the Balloon.

On its firſt being let off, it roſe with ſo much difficulty, that it was for ſome time doubtful whether it would ſucceed or not; at length getting rid of the houſes which ſurrounded it, and conſequently arriving at more expanded air, it gradually aſcended, and took its courſe ſouth weſt for about ſeven minutes, when it was entirely out of ſight.

We could diſcover from the manner of this Balloon getting up, and irregular motion when up, that its beſt form ſhould be circular, as it not only aſcends the higher but the ſteadier; the atmoſpheric air ſurrounding it with more force and impelling it with greater certainty.

A deſire to gratify, as early as poſſible, the public curioſity concerning the experiments of Meſſieurs Charles and Robert with the *Air Balloon*, Dec. 1, 1783, has induced us to lay before them the following abſtract of ſo much of the diſcourſe delivered by the firſt of theſe gentlemen at the opening

* See Page 17.

opening of his courſe of lectures on Natural Philoſophy, as publiſhed in the Journal de Paris, No. 347 and 348, Dec. 13 and 14, 1783, as relates to his aërial voyage.

" Previous to our aſcenſion," ſays Mr. Charles, " we had ſent up a globe of 5 feet 8 inches to diſcover the courſe of wind, and mark out our intended route. The compliment of cutting the ſtring was paid to Mr. Montgolfier, and it inſtantly roſe. Meanwhile we prepared to follow it with impatience; but the perplexing circumſtances* we were in prevented our putting into execution every minute particular that we had intended the night before. The globe and the chariot were in exact equilibrium on the ground. At three quarters after one, we threw out 19 pounds of ballaſt, and roſe in the midſt of a profound ſilence, occaſioned by the emotion and aſtoniſhment of both parties. Our firſt pleaſing reflections on our eſcape from the perſecution and calumny which had attacked us, were heightened by the majeſtic ſcene which preſented itſelf to our view; on every ſide a moſt ſerene ſky, without a cloud, and a moſt charming diſtant proſpect. As we aſcended by an accelerated progreſſive motion, we waved our banner in token of joy, and, in order the better to inſure our ſafety, I was particularly attentive to the barometer. M. Robert examined the cargo with which our friends had ballaſted our chariot, as for a long voyage, of champaign, &c. blankets, and furs.—Having enough, and to ſpare, he began with throwing out one of the blankets, which ſpread itſelf in the air, and fell near the dome of the Aſſumption.—The barometer then ſunk 66 inches, and we had ceaſed to aſcend, or, more properly ſpeaking, were arrived at the height of about 300 toiſes. This was the height to which I had undertaken to ſtop, and from this moment, to that of our firſt getting out of ſight of the obſervers at the different ſtations, our horizontal courſe was between 26 inches and 26 inches 8 lines of the mercury, which agrees with the obſervations made at Paris. We took care to throw out our ballaſt in proportion as we deſcended by the inſenſible loſs of inflammable air, and we raiſed ourſelves ſenſibly to the ſame height. Had circumſtances permitted us to regulate this ballaſt with more exactneſs, our courſe would have been almoſt abſolutely horizontal and voluntary.

Having reached the height of Mouſſeaux, which we left a little to the left, we remained for a moment ſtationary. Our chariot turned about, and we then ſiled off, as the wind directed.

* *Les circonſtances orageuſes qui nous preſſoient.*

directed. We ſoon after paſſed the Seine, between St. Ouen and Aſnieres, and leaving Colombe on the left, paſſed almoſt over Gennevilliers. We had croſſed the river a ſecond time; leaving Argenteuil on the left, we paſt at Sanols, Franconville, Eaubonne, St. Leu-Taverny, Villiers, croſt L'Iſle Adam, and afterwards Neſle, where we deſcended. Such were nearly the places over which we muſt have paſſed almoſt perpendicularly. This paſſage makes about 9 Paris leagues, which we ran over in two hours, with ſcarcely any ſenſible agitation in the air. During the whole of this delightful journey we felt not the leaſt uneaſineſs about our own fate or that of the machine. The globe ſuffered no other alteration than the ſucceſſive modifications of dilatation and compreſſion, of which we availed ourſelves, to riſe or deſcend at pleaſure, in any quantity. The thermometer was, for above an hour, between 10 and 12 deg. above 0, owing to the inſide of our chariot having been warmed by the rays of the ſun. Its heat ſoon communicated itſelf to our globe, and contributed, by the dilatation of the inflammable air within, to keep us at the ſame height, without being obliged to lighten our ballaſt; but we ſuffered a greater loſs: the inflammable air dilated by the ſun's heat, eſcaped by the appendage to the globe, which we held in our hands, and looſened, as circumſtances required, to let out the air too much dilated. By this eaſy method we avoided the expanſions and exploſions which perſons unacquainted with theſe matters apprehended. The inflammable air could not break its priſon, ſince it had always a vent, and the atmoſpheric air could not get into the globe, ſince its preſſure made the appendage ſerve as a valve to oppoſe its entrance.

After 56 minutes progreſs we heard the gun which was the ſignal of our diſappearing from the obſervers at Paris. Not being obliged to confine our courſe to an horizontal direction, as we had till then done, we gave ourſelves up to the contemplation of the varied ſcenes in the open country beneath us. We ſhouted *Vive le Roi*, and heard our ſhouts re-echoed. We heard, very diſtinctly, voices ſaying, 'Are not you afraid, my friends? Are not you ſick? What 'a clever thing it is! God preſerve you! Farewel, my 'friends!'—We continued waving our banners, and we ſaw that theſe ſignals redoubled the joy and ſecurity of thoſe below. We ſeveral times came down low enough to be heard: people aſked us whence we came, and what time we ſet out; and we aſcended bidding them farewel.—As circumſtances required, we threw out, ſucceſſively, great coats, muffs,

muffs, clothes. As we ſailed over L'Iſle Adam, we flouriſhed our banners, and aſked after the Prince of Conti; but had the mortification to be told, by a ſpeaking trumpet, that he was at Paris. At length, re-aſcending, we reached the plains of Neſle about half after three, when, as I intended a ſecond expedition, and wiſhed to avail myſelf of the advantage of ſituation, as well as of the day-light, I propoſed to Mr. Robert to deſcend. Seeing a troop of country people running before us over the fields, we deſcended towards a ſpacious meadow, incloſed with ſome trees and buſhes. Our chariot advanced majeſtically over a long inclined plane. As it approached the trees, fearing it might be entangled among them, I threw out two pounds of ballaſt, and it ſprung upwards over them. We ran over above 20 toiſes within one or two feet of the land, and looked like travellers in a ſledge. The country people purſued us as children do a butterfly, without being able to overtake us. At length we came to the ground. As ſoon as the curate and ſyndics could be brought to the ſpot, I drew up a verbal proceſs, which they immediately ſigned. Preſently galloped up the Duke de Chartres, the Duke de Fitz-James, Mr. Farrer, an Engliſh gentleman, and a number of horſemen, who had followed us from Paris. Fortunately we alighted near a hunting-ſeat of the latter, who immediately mounted his horſe, and riding up to us, exclaimed, "Mr. Charles, I am firſt." The Prince embraced us both in our chariot, and ſigned the proceſs. So did the Duke de Fitz-James. Mr. Farrer ſigned it 3 times. His ſignature was omitted in the Journal, for he was ſo tranſported with joy, that he could not write legibly. Of above 200 horſemen who followed us from Paris, only theſe could overtake us; the reſt had knocked up their horſes, or given out. After relating a few particulars to the Duke de Chartres, I told him I was going off again, when would he have me return? He replied, in half an hour. Mr. Robert quitted the chariot, as we had agreed. Thirty peaſants held down the machine. I aſked for ſome earth to ballaſt it, having not above 4 or 5 pounds left. A ſpade was not at hand, nor were there any ſtones in the meadow. The ſun was near ſetting. I made a haſty calculation of the time requiſite for the alteration of weight, and giving a ſignal to the peaſants to quit their hold, I ſprung up like a bird. In 20 minutes I was 1500 toiſes high, out of ſight of all terreſtrial objects. I had taken the neceſſary precautions againſt the exploſion of the

globe,

globe, and prepared to make the obſervations which I had promiſed myſelf. In order to obſerve the barometer and thermometer placed at the ends of the chariot, without altering the center of gravity, I knelt down in the middle, ſtretching forwards my body and one leg, holding my watch and paper in my left, and my pen and the ſtring of the valve in my right, waiting for the event. The globe, which, at my ſetting out, was rather flaccid, ſwelled inſenſibly. The air eſcaped in great quantities at the valve. I drew the valve from time to time, to give it two vents; and I continued to aſcend, ſtill loſing air, which iſſued out hiſſing, and became viſible, like a warm vapour in a cold atmoſphere. The reaſon of this phænomenon is obvious. On earth the thermometer was 7 degrees above the freezing point; after 10 minutes aſcent it was 5 degrees below. The inflammable air had not had time to recover the equilibrium of its temperature. Its elaſtic equilibrium being quicker than that of the heat, there muſt eſcape a greater quantity than that which the external dilatation of the air could determine by its leaſt preſſure. For myſelf, though expoſed to the open air, I paſſed, in 10 minutes, from the warmth of ſpring to the cold of winter, a ſharp dry cold, but not too much to be borne. I declare, that in the firſt moment I felt nothing diſagreeable in the ſudden change. When the barometer ceaſed to riſe, I marked exactly 18 inches 10 lines, the mercury ſuffering no ſenſible oſcillation. From this oſcillation I deduct a height of 1524 toiſes, or thereabouts, till I can be more exact in my calculation. In a few minutes more my fingers were benumbed by the cold, ſo that I could not hold my pen. I was now ſtationary, and moved only in an horizontal direction. I roſe up in the middle of the chariot, to contemplate the ſcene around me. At my ſetting out the ſun was ſet on the valleys; he ſoon roſe for me alone, who was the only luminous body in the horizon, and all the reſt of nature in ſhade. The ſun himſelf preſently diſappeared, and I had the pleaſure of ſeeing him ſet twice in the ſame day. I beheld, for a few ſeconds, the circumambient air and the vapours riſing from the vallies and rivers. The clouds ſeemed to riſe from the earth, and collect one upon another, ſtill preſerving their uſual form, only their colour was grey and monotonous from the want of light in the atmoſphere. The moon alone enlightened them, and ſhewed me that I was tacking about twice, and I obſerved certain currents that brought me back again. I had ſeveral ſenſible deviations, and obſerved, with ſurpriſe, the effects of the wind, and ſaw

the

the ſtreamers of my banners point upwards. This phænomenon was not the effect of the aſcent or deſcent, for I then moved horizontally. At that inſtant I conceived, perhaps a little too haſtily, the idea of being able to ſteer one's own courſe. In the midſt of my tranſports I felt a violent pain in my right ear and jaw, which I aſcribed to the dilatation of the air in the cellular conſtruction of thoſe organs, as much as to that of the external air. I was in a waiſtcoat, and bareheaded. I immediately put on a woollen cap, yet the pain did not go off but as I gradually deſcended. For 7 or 8 minutes I had ceaſed to aſcend; the condenſation of the internal inflammable air rather made me deſcend. I now recollected my promiſe to return in half an hour, and, pulling the upper valve, I came down. The globe was now ſo much emptied, that it appeared only an half-globe. I perceived a fine ploughed field near the wood of Tour du Lay, and haſtened my deſcent. When I was between 20 and 30 toiſes from the earth, I threw out haſtily 2 or 3 pounds of ballaſt, and became, for a moment, ſtationary, till I deſcended gently on the field, above a league from the place whence I ſet out. The frequent deviations and turnings about make me imagine this voyage was about 3 leagues, and I was gone about 35 minutes. Such is the certainty of the combinations of our aëroſtatic machine, that I can at pleaſure complete 130 ſpecific lightneſs, the preſervation of which, equally voluntary, might have kept me in the air at leaſt for 24 hours longer. When the two Dukes ſaw me at a diſtance coming down, they and the reſt left M. Robert to meet me, and haſtened to Paris; and the Prince himſelf moſt kindly undertook to give the publick an account of us, and to quiet their apprehenſions for us."

FINIS.

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